WE CLAIM:

- 1. A method for non-intrusively measuring carbon dioxide
- (CO_2) in a high temperature gas flow containing water vapor
- (H_2O) , said method comprising:
- 4 providing a laser sensor;
- operating said laser sensor at a selective wavelength
- substantially near 2 μ m,
 - selecting the R(50) spectroscopic transition of the $v_1+2v_2+v_3$ CO₂ absorption band in near-infrared;

utilizing said laser sensor to spectrally interrogate said R(50) spectroscopic transition for sensitive measurements of CO_2 , wherein said R(50) spectroscopic transition is substantially isolated from interfering absorption by high temperature species including said water vapor (H_2O) present in said high temperature gas flow.

- 2. The method of claim 1, wherein said high temperature is characterized to be more than 400 K.
- 3. The method of claim 1, wherein said interfering high
- temperature species further comprising CO, $\mathrm{NH_3}$, $\mathrm{N_2O}$, and NO .
- 1 4. The method of claim 1, wherein said gas flow is generated
- by a combustor and said measurements of CO₂ are taken in situ
- 3 in said combustor.
- 1 5. The method of claim 1, wherein said measurements of CO_2
- 2 are taken in a process chamber or in a sampling line.

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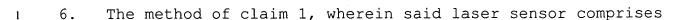
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- a fiber-coupled distributed feedback diode laser.
- 7. The method of claim 1, wherein said laser sensor comprises
- a non-fiber-coupled laser, a Fabry-Perot (FP) diode laser, a
- distributed Bragg reflector (DBR) laser, a quantum cascade
- laser, an edge-emitting diode laser, or a vertical cavity
- surface-emitting laser (VCSEL).
 - 8. The method of claim 1, wherein said interrogation utilizes a spectrally resolved technique comprising scanned—and fixed—wavelength absorption, balanced ratiometric detection, frequency-modulation (FM) spectroscopy, photothermal deflection, and photoacoustic spectroscopy.
 - 9. A system having a plurality of multiplexed laser sensors operating at a plurality of selective wavelengths for non-intrusively and simultaneously measuring combustion parameters including carbon dioxide (CO_2) along a single optical path in a high temperature gas flow containing water vapor (H_2O), wherein the improvement comprising:

one of said laser sensors operating at a wavelength substantially near 2 μ m spectrally interrogates a selective R(50) spectroscopic transition of the $v_1+2v_2+v_3$ CO₂ absorption band in near-infrared for accurate measurements of CO₂, wherein said R(50) spectroscopic transition is substantially isolated from interfering absorption by high temperature

species present in said high temperature gas flow.

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- 1 10. The system of claim 9 further comprising:
- a multimode optical fiber into which output beams from
- 3 said multiplexed lasers are combined;
- a collimating lens for directing said combined output
- beams through said high temperature gas flow; and
- a diffraction grating for demultiplexing said combined
- output beams so that transmitted intensity from each of said
- 8 plurality of laser sensors as well as said combustion
- 9 parameters can be simultaneously independently monitored along
 - said single optical path by a plurality of detectors.
 - 11. The system of claim 10, wherein said combustion parameters further comprise $\rm H_2O$ and temperature.
 - 12. The system of claim 10, wherein said plurality of detectors comprise extended wavelength response detectors.
 - 13. The system of claim 9, wherein said high temperature is characterized to be more than 400 K.
- 1 14. The system of claim 9, wherein said interfering high
- temperature species comprises said water vapor.
- 1 15. The system of claim 14, wherein said interfering high
- temperature species further comprises CO, NH_3 , N_2O , and NO.
- 1 16. The system of claim 9, wherein said gas flow is generated
- by a combustor and said measurements of CO₂ are taken in situ
- 3 in said combustor.

- 1 17. The system of claim 9, wherein said measurements of CO_2
- are taken in a process chamber or in a sampling line.
- 1 18. The system of claim 9, wherein said plurality of laser
- sensors are characterized as fiber-coupled distributed feedback
- 3 diode lasers.
- 1 19. The system of claim 9, wherein said plurality of laser
- sensors are characterized as non-fiber-coupled lasers, Fabry-
 - Perot (FP) diode lasers, distributed Bragg reflector (DBR)
 - lasers, quantum cascade lasers, edge-emitting diode lasers, or
 - vertical cavity surface-emitting lasers (VCSEL).
 - 20. The system of claim 9, wherein said interrogation utilizes a spectrally resolved technique comprising scanned- and fixed-wavelength absorption, balanced ratiometric detection, frequency-modulation (FM) spectroscopy, photothermal deflection, and photoacoustic spectroscopy.